

## THE PREDICTION OF SEX.

By JOHN STOCKTON-HOUGH, M. D.,  
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## I.

Some additional observations on the revival of an old theory of the production of the sexes, through recent experiments, by partial castration.

**A**MONG the multitude of theories that have been advanced from time immemorial concerning the causes which determine the sex of the embryo, none had more respectable sponsors in ancient times, and few have been so thoroughly neglected in the last century, as the theory embodied in the belief that the product of the right testicle of the male, impregnating an egg, causes the sex of the progeny to be male, and the semen of the left testicle determines the female sex.

Columella, Varro, and other respectable writers on husbandry, in ancient times, taught this theory, and advised that the testicle not desired should be ligated at the time the services of the other were needed.

Aristotle was also of the opinion that the testicle of the right side determined the male sex, and that of the left side, the female sex.

In my previous paper, in the March number of the BULLETIN, I mentioned the fact that Dr. Funkhouser, of St. Louis, had made several experiments on dogs, rabbits and fowls, in extirpating one or the other testicle of the male, with a view of determining whether the semen from one side or testicle would always produce young exclusively of one sex, or sometimes of one sex and sometimes of another. He asserts that these experiments prove that the semen coming from the right testicle, impregnating an ovum, causes it to become male, and the semen from the left testicle determines the female sex in the embryo. He prepared more than a score of partially castrated males, of dogs, rabbits and fowls,—extirpating sometimes the right testicle, sometimes the left. These males were coupled with different females, and in every instance, save one (which he claims he can explain), was the resultant embryo\* of the sex he had expressly determined.

\*Funkhouser—Laws determining sex. *Weekly Medical Review*, Chicago, July 5th and 12th, and August 23rd, 1884.

Since the publication of the above I have found among my collection, notices of other experimenters in this direction. Among them are the following:—Dr. Sixt,<sup>†</sup> author of a manuscript in German, which was translated into English, and edited by Dr. Trall, of N. Y., where it was published about 1861–5—copious extracts from which may be found in Dr. Trall's book on Sexual Physiology. Dr. Sixt claims also that by extirpating one or the other of the testicles he could cause the production of either sex at will.

In the number of the *Scientific American* for May 6th, 1865, p. 293, there appeared a notice or announcement of what was termed a "New Discovery of the Breeding of Sex." Its author, M. de Ferrandi, says, that "for several years I have been in possession of this knowledge, (i. e. that of 'the breeding of sex') and being a Frenchman, I had intended to communicate it to the Academy of Sciences at Paris; but illness has prevented my return to France. Fearing that my secret may perish with me, as in the case of Segato, I have decided to publish it for the benefit of all civilized people."

"It is the male who engenders the substance destined already to be of the masculine sex or the feminine, before the female receives it. The right apparatus engenders the male, the left the female. By operating a partial castration, therefore, of the male, it is easy for stock raisers to procure offspring all of either sex.

"At La Hotte, near Fort Liberty, in Hayti, this process has been in operation for several years, and for the twelve years that I have watched the result it has never failed."

We have now cited three respectable, and, so far as we know, reputable authorities, who claim to have witnessed others, or proved for themselves, that by the extirpation of the right testicle, females only were engendered, and by the extirpation of the left tes-

ticle, males only were produced. One observer claims that it never failed in the twelve years that he watched the experiments, and Dr. Funkhouser has already been experimenting several years; and Sixt, more than a hundred years ago, claims to have always succeeded in his numerous experiments.

There is no theory of the production of the sexes which can be so easily submitted to a practical test as this one. Almost any one can extirpate one testicle of a dog, hog, bull, colt, rabbit, cat or cockerel, and within a year, or at most 18 months, the result may be known. The greater the number of experimenters the more valuable the results. Let some one who reads this be stimulated to try it.

In left-handed individuals it is possible that the functions prevailing as described in right-handed individuals may be reversed. If possible select those animals having the left apparatus larger and more pendulous than that of the right side; a condition which usually accompanies right-handedness. How far structural or functional peculiarities which accompany right or left-handedness in man, prevail among the lower animals, has not as yet been thoroughly investigated. We know, however, that certain of the lower animals have one sex on one side of the body and the other sex on the other side.

In selecting animals for experiments those having anything unusual in their formation should be rejected.

A curious fact, related by M. Isidore Geoffroy Saint-Hilaire, may be found recorded in the *Dictionnaire Classique d'Histoire Naturelle*, etc., which would seem to indicate that the male parent determines the sex of the embryo.

"A bitch, of a large race, coming from the St. Bernard, was covered successively by an ordinary hunting dog, and by a Newfoundland; she gave birth in May, 1824, to 11 pups, which presented the following characters: Six of them resembled the Hunting dog, the other five resembled the Newfoundland dog. These animals differed so much that one found it difficult to believe that they were of the same mother. The young Newfoundland

<sup>†</sup>Sixt (P. F.) (of Erfurt, Germany), An Exposition of the Mysteries of Nature concerning the Generation of Man and the voluntary choice of the Sex of the Progeny. Edited by R. T. Trall, and published in N. Y. (before 1860) from the German (Manuscript of about 1770–1800).



pups were of an entirely different color from the others, and twice as large. The six that resembled the Hunting dog were *all females*, the five that resembled the Newfoundland were *all males*. This bitch had had other litters of pups but never so many at a time."

## II.

### PREDICTION OF THE SEX FROM THE SIZE AND SHAPE OF THE EGG.

Horatius Flaccus (B. 11, Sat. 4. 1. 12) expresses it as his opinion that those eggs which are of an oblong shape are of the most agreeable flavor. The longer eggs are those which produce the male; the rounder, the female, according to Pliny (B. x. c. 74).

The following are Horace's lines, with a liberal translation by Dr. Philip Frances:

*Longa quibus facies ovis erit, ille memento,  
Ut succi melioris, et ut magis alba rotundis.*

Long be your eggs, far sweeter than the round,  
Cock eggs they are, more nourishing and sound.

Mr. Trotter, in No. 27 of the Journal of the Royal Agricultural Soc. (p. 181), says, "Select the round eggs, for they contain female birds, and reject the oblong shaped, for they contain birds of the opposite sex." Again, "By the position of the air cell at the but-end of the egg, those may be selected that will produce the male sex; in these the air cell is in the centre of the end. If the cell be a little on one side the egg will produce a female chick." Mr. Dixon, in his work on Domestic Poultry (pp. 165-169), thinks this improbable; but he and all other sceptics agree "that of twenty-four eggs laid by a single hen, the twelve largest would give a great majority of male birds, the others, the same of pullets." Columella† says: "He who desires to have the greater number of his brood cocks, let him select the longest and sharpest eggs for incubation; and, on the contrary, when he would have the greater number females, let him choose the roundest eggs." Pliny is of the same opinion; but Aristotle§ is diametrically opposed, *according to some*



*translators*, but commentators tell us that this is a misinterpretation of his meaning. "The ground of Aristotle's opinion was," says Harvey,|| "because the rounder eggs are the hotter, and it is the property of heat to concentrate and determine, and that heat can do most which is most powerful. From the stronger and more perfect principle, therefore, proceeds the stronger and more perfect animal. Such is the male compared with the female, especially in the case of the common fowl." Harvey, in continuation, very justly remarks, that the differences indicated are to be understood as referring to the eggs of the Game fowl; for when a certain hen goes on laying eggs of a certain character, they will all produce either males or females. If you understand this point otherwise, the guess as to males or females, from the indications given, would be extremely uncertain; because different hens lay eggs that differ much in respect of size and figure; some habitually lay more oblong, others, rounder eggs that do not differ greatly from one another; and al-

though I sometimes found diversities in the eggs of the same fowl, these were still so trifling in amount that they would have escaped any other than the practised eye. For as all the eggs of the same fowl acquire nearly the same figure in the same womb or mould in which the shell is deposited, it necessarily falls out that they greatly resemble one another; so that I myself, without much experience, could readily tell which hen in a small flock had laid a given egg." In conclusion he very wisely says: "I wish there were some equally ready way for the child of knowing the true father." Cresswell translates Aristotle as follows: "In the egg there is a difference, for one end is pointed, the other round. The round end is laid first. The large sharp eggs are males; those which are round and circular at the sharp end are females. (Aristot. Hist. of Animals., B. vi. ch. 11, p. 2.)

Mr. Browne, in his poultry book, says that it is absurd to believe that there is any relation between the shape of an egg and the sex of the product, as the same hen always lays eggs of same color, shape, &c., and every one

† De Re Rustica. Cap. 5. Scalig. in loc.

§ Hist. Anim. lib. vi. cap. 2 ("Long and sharp eggs are females, but those that are spherical and have a convexity close to the sharp end are males.")

|| Gener. Anim. p. 217.



knows that one hen does not breed all males, and another all females. While it is true that there is a certain general resemblance among the eggs laid by the same hen, yet we know that there is a great difference in the size of the same hen's eggs, and I shall presently show that there is a great difference in the proportion of the conjugate diameters.

In the year 1872 I procured 10 duck eggs, the majority of which were noticed to be particularly long. From these 10 eggs five drakes and two ducks were hatched. These two ducks and one of the drakes were kept over until the next year, and in the Spring they commenced to lay. One duck laid perfectly white eggs, and the other decidedly blue eggs. The white eggs were larger and longer than the blue. The date was written on each egg the day it was laid and gathered, and the largest and shortest circumferences were measured and recorded. The greatest circumference lengthwise, of any white egg, was  $8\frac{1}{8}$  inches, the circumference at right angles to this,  $6\frac{1}{2}$  inches. The same measurements of the smallest white egg was  $5\frac{3}{8}$  by  $4\frac{3}{16}$ ; this last was the first egg laid, the large egg was the eleventh laid. The tenth egg measured  $6\frac{7}{8}$  by  $5\frac{5}{8}$ . The largest blue egg was  $6\frac{7}{8}$  by  $5\frac{7}{8}$ ; the smallest was  $4\frac{3}{4}$  by  $3\frac{7}{8}$ . These measurements were very carefully and accurately made and recorded, and it was my intention to note the sex of the product of each egg as it hatched out, but unfortunately I was not able to be present at the time they were hatched. I had thus tabulated the order in which each egg was laid, and the proportion of length to breadth.

"Experienced cultivators of the silk-worm are generally able to distinguish the male from the female cocoon by the more pointed ends of the former." The sex of the forthcoming product is much more easily foretold than determined by any examination shortly after birth, except by dissection. This is also true of the hen's eggs, there being no guide in either case to the sex of the product in its earlier days of existence, except, perhaps, the size, which is so little as to require very

careful measurement or weighing, and even by this means I question very much if the latter method would yield as large a proportion of successful results as that of prediction.

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copies of which will be sent to any address for  
ten cents each.)

### III.

#### THE POSITION OF THE AIR-CELL WITH REFERENCE TO SEX.

There is a popular notion among certain people in all countries that by determining the location or position of the air-cell, one may predict the sex of the forthcoming chick. Columella, in his *Husbandry*, and many other writers on rural affairs, both ancient and modern, have taught that where the air-cell is exactly in the centre of the large end the product will be a male, when it is a little to one side it will be a female. I think no importance is to be attached to this idea. One wonders why the air-cell should not be on one side, the weight of the egg, lying as it must on its side,

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one would think would cause the air entering to rise to the highest point; the only way to account for its usual location at the larger end, is the probable greater porosity of that end—and as the egg loses moisture after being laid the air enters the most porous part to take the place of the water lost by evaporation.

Girou\* (*Observations sur la Reproduction des Oiseaux domestiques*) wished to know whether large or small, long or short eggs, yield most males or females.

"Rozier has asserted his having observed in turkeys that, when the animal has issued from the egg, and several days after, the female is larger than the male; and has added, that, by following this indication, one need not be deceived as to the sex of these

birds. But facts only prove that, among the largest of newly-hatched turkeys, there are somewhat more females than males; and this is the only fact which I have yet obtained from my observations on the reproduction of these birds;" he having, through unfavorable weather and accidents, lost nearly all his turkey and duck eggs which were subjected to experimentation, the common hen furnishing the eggs for the following observations.

In continuing, he says: "I could only compare together the eggs produced in the same poultry yard; for the eggs which seem large in one place seem small in another, on account of the difference of the races, which is determined by that of the food.

"It is only by their weight that the volume of eggs can always be judged of; for the largest often weigh less than the smallest, when they have not

been laid at the same period, on account of the evaporation of the humid part. They ought, therefore, to be measured; and the most accurate measure is that obtained by the displacement of water, the weight of which may, for more convenience, represent the volume of the body which has displaced it.

"However, in 1826, I weighed the eggs themselves, after separating the larger from the smaller, and the weights obtained confirmed my ideas as to the relative volume.

"In 1827 I proceeded in the following manner: After forming the settings by bringing together the eggs which appeared the largest, and afterwards the smallest, I immersed at once all the eggs of the same setting in a vessel exactly filled with water, and placed it in another empty vessel. The water, which by this immersion passed into the second vessel, was accurately weighed, and its weight represented the total volume of the setting. On dividing this weight by the number of eggs, I obtained a mean representation of volume for each egg.

"To avoid all confusion, I make particular marks with ink on each of the settings. I marked the chickens the moment they were hatched by cutting off one of their claws. This mode of marking is very simple, but care must be taken to renew it every fortnight, for the cut claw sprouts, and at length does not differ from the rest."

\* \* \* \* \*

The following are the results of the experiments of 1826:

#### DEMESNE OF GOUDALIE.

	Males Females	
30 hen's eggs, of a spherical form, and of a mean weight of 54.33 grammes, yielded.....	15	15
60 hen's eggs, of an elongated form, and of the same weight as the preceding, yielded.....	30	30
8 eggs of spherical form, and of the weight 47.56 gr., yielded.....	7	1

#### DEMESNE OF BUZAREINGUES.

	Males Females	
60 turkey's eggs, of the mean weight of 69.50 gr. produced by females one year old, and of small size, yielded.....	40	20

"In the latter demesne, a third setting, the eggs of which were, to appearance, larger than those of the first, and smaller than those of the second,

\*Cited in Edinburgh New Philosophical Journ. V. VI., 1829, pp. 336-340, from *Annales des Sci. Naturelles*.



yielded 6 males and 3 females; and a fourth setting, the eggs of which were laid by a tufted hen, the favorite of the mistress of the house, and consequently well fed, produced 5 males and 7 females.

#### EXPERIMENTS OF 1827.

##### DEMESNE OF BUZAREINGUES.

Dates of Incubation	N <sup>o</sup> . of products where sex was determined.	Mean weight of placed by each egg.	Males.	Females.	Observations.
June 6.	16	40.76 gr.	9	7	
May 21.	22	41.15	14	8	Hatched June 11, noon.
May 14.	16	43.68	9	7	" " 4.
Mar. 28.	13	44.64	6	7	
June 6.	6	45.44	5	1	
May 21.	20	46.52	10	10	Hatched June 11, afternoon
June 6.	5	46.88	1	4	
May 14.	17	47.04	8	9	Hatched June 5.
June 6.	10	53.00	4	6	
DEMESNE OF LECURE.*					
May 13.	11	49.20	8	3	
April 22	10	50.93	6	4	

\* The hens of this demesne are larger than those of Buzareingues.

"The total of these different broods is 183 males and 152 females.

"If these results are confirmed by new and numerous experiments, as the volume of the eggs is in relation with that of the birds, it will be established, 1st, that, in the same poultry yard, and under the same race of fowls, the larger females produce a greater proportional number of females than the smaller; 2nd, that there is no certain relation between the sex of chicken and the form of the egg; 3rd, that the small eggs are longer in being hatched than the large; 4th, that in the gallinaceæ the predominance of the male sex is greater than in the mammiferae.

"Old hens lay large eggs, and if birds obey the same laws of reproduction as the mammiferae, these eggs ought to yield as many males as the smallest. Now, it will be remarked that predominance of the males furnished by the small eggs is greater than that of the females furnished by the large eggs. It may also be remarked, that the very young females which have not acquired a precocious development, yield a great proportional number of males. It is therefore probable that the same laws of reproduction are common to the mammiferae and to birds.

"The comparative trial of round egg and long eggs was made by my orders, but not under my inspection;

and, although I do not view the results with suspicion, I cannot warrant them.

"Some facts seem to prove, that, according to the common opinion of housewives, it is not a matter of indifference to lay down eggs for hatching under all the phases of the moon, and that the result is so much the more satisfactory the nearer the hatching is to the full moon. All the settings of the demesne of Buzareingues, in 1827, were composed of 25 eggs. Now, as may be seen from the above table, the success of these hatchings has been in the following order: 1st, those of the 21st of May; 2nd, those of the 14th of May; 3rd, those of the 28th of March; 4th, those of the 6th of June. The hatching of the first took place on the 16th day of the moon; of the second on the 10th; of the third on the 21st; and of the fourth on the 4th. The intervals between these periods and full moon are 2, 4, 7 and 10 days. Might not these relations, if they are constant, be the effects of the influence of light or darkness on the state of agitation or rest of the hen? By too much heat, the hen's sitting constantly kills the young, or thwarts their development."

#### IV.

##### INFLUENCE OF THE ORDER IN WHICH THE EGGS ARE LAID BY THE FEMALE ON THE SEX OF THE BIRD THEY WILL PRODUCE.

It is a well-known fact that pigeons, doves, and all of that tribe, lay but two eggs, rarely three, but never more than two hatch, the other becomes addled when there are three. There is usually one male and one female produced from these two eggs, and the male is often hatched first; and having laid an egg one day she omits many days and then lays another. I think Aristotle says that the egg which produces a male is usually laid first, or before the one that produces the female.

In 1850 Dr. Silas Hubbard, then of Buffalo, N. Y., announced in the *Buffalo Med. Jour.* (1850, p. 252; Apr. 1855, p. 644) that in man males are begotten just before the menstrual epoch, and females just after, from which he reasoned that males were begotten

from immature eggs, and females from mature eggs.

Mr. Thury,<sup>†</sup> of Geneva, Switzerland, in 1863, announced his theory, which is just the reverse of the above—viz., females are begotten at and just after the menstrual period, and males are begotten several days after this period. Consequently females are begotten from immature eggs, and males from mature eggs. This latter theory has created more serious interest and observation at the hands of scientists than any other ever enunciated. Translations of his pamphlet exist in German and English, and nearly every medical and scientific journal has had something to say concerning it. M. Coste,<sup>‡</sup> the great embryologist, in conjunction with Mr. Gerbe, made some experiments on fowls, which he claimed disproved this theory, at least its applicability to birds. He made the following experiments on fowls:

Laying hens were kept separated from the cock for a long period—then a cock was penned up with them—from the eggs laid after the cock had been placed with them, chicks of both sexes were hatched, with no regularity in the order of the production of the sexes—sometimes males from the first eggs, sometimes females.

It was also determined that a hen would lay fertile eggs for 10 days after she had been excluded from the approaches of the cock.

"Dr. Hubbard,<sup>||</sup> alleges that in the case of the turkey hen, one copulation impregnates the ova laid during the season, or for two broods, and farmers, he says, inform him that the first brood are principally females, and the last brood principally males. From another source I have it, that among domestic poultry, the last eggs laid nearly always produce the cocks of the clutch."

Dr. Hubbard tried some experiments with hens, and found that when the first half of a hatch of eggs laid by a

<sup>†</sup> Mémoire sur la loi de la production des sexes chez les plantes, les animaux et l'homme. Genève, 1863, 8°, 28 pp.

<sup>‡</sup> Mémoire sur "la production des sexes." *Compte Rendus des Séances de l'Acad. des Sci.* 8 Mai, 1865, pp. 941-949. *Ann. 1864*, 139-140

<sup>||</sup> The Peoria Medical Monthly, June 1881, p. 53.



hen were hatched, they principally developed into hens, but the last half laid mainly developed into roosters.

M. Girou asserts that it is a well-known fact that the eggs produced before the month of July give more males than those produced after the month of June. From his table I take the following figures:—Of 169 eggs laid before the month of July, displacing on an average .0441 kilogrammes of water, hatched out 141 chicks, 75 males and 53 females. Another lot of 119 eggs, in same series, gave 37 males and 51 females, making 112 males and 104 females, or, 107 males to 100 females. From 132 eggs laid after the month of June, displacing on an average .0444 kilogrammes of water, 118 chicks were hatched, 55 of which were males and 61 females, or 90 males to 100 females.

From this same table he claims to show that by coupling strong cocks with weak hens he produced 1415 males to 1000 females; weak cocks with strong hens, produced 725 males to 1000 females.

In conclusion M. Girou observes, that one may remark in the tables that precede, that the relative number of females was not always in relation with the volume of the egg; and that a setting of 25 eggs of the smallest dimensions gave 11 males and 13 females; while another setting of 25 eggs of larger size gave 13 males and 10 females. It is not then, as one might think, the nourishment which determines the sex of the embryo, it is already decided at the moment of fecundation, and it depends on the relative condition of the father and the mother, or rather of their reproductive formations.

\* \* \* The volume of the egg is only a slight index of the state of the female when she receives the male, but it does not indicate the condition of the latter, and consequently one announces one of the terms of the relation, which ought to be represented in the embryo. I say it is only a slight index of the state of the female; it is, in fact, ordinarily in harmony with the size, race and color of the hen; notwithstanding a pullet, well developed and disposed

to procreate females, produces smaller eggs than an old hen disposed to procreate males; and the largest eggs, which are very often furnished by the oldest hens, are sometimes those which give the most males; from which *we conclude, that taking the eggs at random coming from hens of different ages, the volume of the eggs could only authorize feeble conjectures on the sex of the chick it may produce.*

To breeders of animals interested in the laws determining the production of the sexes, I commend the following series of books, recently published, which may be procured through any foreign bookseller:

Janke, (H.)—Die Vorausbestimmung des Geschlechts, beim Rinde, 8°, Berlin, 1881, 100 pp. 50 cts.

Düsing, (C.)—Die Regulierung des Geschlechts verhältnisses bei der

Menschen, Tiere und Pflanzen, 8°, Jena, 1884, 364 pp. Costs \$1.50. Reviewed in Popular Sci. Monthly, January, 1885.

Starkweather, (G. B.)—The Law of Sex, 8°, London, 1883. \$4.00.

Lioy, (P.)—Sulla legge della Produzione dei Sessi, 8°, Milano, E. Treves, 1872, 362 pp. 50 cts.

Miles Manly. — Stock-Breeding, 8vo, N. Y., 1879.